

**DRAFT
TECHNICAL MEMORANDUM NO. 3**

**ADDENDUM TO FINAL PHASE I
RFI/RI WORK PLAN**

Surface Soil Sampling Plan - Original Landfill

**Rocky Flats Plant
Woman Creek Priority Drainage**

(Operable Unit No. 5)

**EG&G ROCKY FLATS, INC.
P.O. Box 464
Golden, Colorado 80402-0464**

Prepared for:

**U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado**

December 1992

ADMIN RECORD

A-DU05-000116

REVIEWED FOR CLASSIFICATION/UCNI
By *[Signature]*
Date *1/15/93* *(initials)*

TABLE OF CONTENTS

<u>Section</u>	<u>Page</u>
1.0 INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PURPOSE AND SCOPE	3
2.0 PRELIMINARY FIELD ACTIVITIES	3
2.1 AERIAL PHOTO REVIEW	4
2.2 RADIATION SURVEY	5
2.3 GEOPHYSICAL SURVEYS	8
2.4 SOIL ORGANIC VAPOR SURVEY	8
3.0 SURFACE SOIL SAMPLING PROGRAM	10
3.1 SOIL SAMPLE LOCATIONS - LANDFILL	10
3.2 FIELD PROCEDURES	24
3.3 ANALYTICAL PARAMETERS	26
4.0 REFERENCES	30

<u>List of Figures</u>	<u>Page</u>
1 Original Landfill and Extended Areas	2
2 Radiation Survey Hot Spots	7
3 Original Landfill and Disturbed Area Surface Soil Sample Locations	17

List of Tables

Page

1	Radiation Hot Spots and Disturbed Area Surface Soil Sample Location Numbers State Plane Coordinates and Sample Numbers - IHSS 115	9
2	IHSS 115 Analytical Parameters	11
3	Random Surface Soil Sample Location Numbers State Plane Coordinates and Sample Numbers - IHSS 115	21
4	Analytes, Sample Containers, Preservatives, and Holding Times	28

Appendix

1	EG&G Sample Documentation Forms	32
---	---	----

DRAFT TECHNICAL MEMORANDUM SURFACE SOIL SAMPLING PLAN

1.0 INTRODUCTION

1.1 BACKGROUND

As part of the Rocky Flats Environmental Restoration program, a multiple staged Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) is being conducted for Operable Unit 5 (OU5). Located within OU5 is Individual Hazardous Substance Site (IHSS) 115, the Original Landfill for the Rocky Flats Plant. IHSS 115 was in service from 1952 to 1968 and was used to dispose of general plant wastes which may have included 1,1,1-trichloroethane, dichloromethane, benzene, paint and paint thinners, oil, pesticides, beryllium, uranium, lead and chromium (DOE, 1992).

IHSS 115 is being evaluated in a 5 stage effort as part of the Phase I RFI/RI Work Plan. The 5 stages are summarized as follows, Stage 1 - review of existing data, Stage 2 - field screening surveys, Stage 3 - multimedia surface sampling, Stage 4 - multimedia subsurface sampling, and Stage 5 - additional sampling as needed based on the unique characteristics of the IHSS.

During Stage 1, aerial photographs, the operational history of the landfill and field investigations by the Colorado Department of Health (CDH) and the Environmental Protection Agency (EPA) were used to redefine the boundary of the landfill. The redefined landfill boundary and the previous boundary are shown in Figure 1. Approximately 446,000 square feet are encompassed by the landfill over elevations ranging from approximately 5,940 feet to 6,050 feet above mean sea level.

1.2 PURPOSE AND SCOPE

A surface soil sampling program is proposed as part of the Stage 3 RFI/RI field activities for IHSS 115, the original landfill. The purpose of the surface soil sampling program is to characterize radiological and chemical parameters within the landfill cover for risk assessment and to investigate contaminant anomalies identified in the Stage 1 data review and Stage 2 field screening surveys (DOE, 1992). The primary purpose of Technical Memorandum 3 (TM3) is to specify the Stage 3 surface soil sample locations and the locations of surface soil samples to be collected at areas exhibiting radioactivity above natural background (hot spots). It is being proposed now to make the soil sampling plan a two phased plan. The first phase would commence on the approval of TM3 as outlined herein. The second phase, if necessary, would be completed at the conclusion of the electro-magnetic, magnetic and soil organic vapor (SOV) surveys. This approach is suggested to (1) expedite the soil sampling at IHSS 115, and (2) to help to alleviate the bottleneck currently being experienced at the analytical laboratories by potentially spreading sample collection over a longer period of time by starting work earlier. If after a review of the electro-magnetic, magnetic and SOV surveys, the areal extent of the landfill is increased, a Technical Memorandum will address those changes and if necessary a second phase soil sampling program will be implemented. If the boundary of the landfill does not change based upon this information or is decreased in size there would be no additional soil sampling.

2.0 PRELIMINARY FIELD ACTIVITIES

Stage 1 preliminary data gathering activities have been completed. The Aerial Photographic Analysis Comparison Report, US DOE Rocky Flats, Golden Colorado, Appendix A, EPA Region 8 (EPA, 1988) has been reviewed and a series of oblique aerial photographs intermittently spanning the period of February 6, 1966 to June 26, 1991 were also reviewed. The results of a 1990 gamma radiation survey as published in Volume II of the OU5 Phase I RFI/RI Work Plan have been reviewed.

2.1 AERIAL PHOTO REVIEW

Dimensions and boundaries of the original landfill have been estimated from aerial photos and have been transferred to a 1" = 200' scale map of the site (Figure 1). The conclusions drawn from the aerial photo review are summarized below.

1. A suspect area shown as disturbed ground and a possible pit off the west end of IHSS 115 has been included within the investigation area of IHSS 115.
2. The surface disturbance east of the landfill (Figure 1) has been enlarged to include an area interpreted as rubble east of the road on the east side of the surface disturbance. This interpretation is based on an evaluation of the aerial photographs, in particular oblique photographs taken in December, 1987 that clearly define the rubble piles. This is now being interpreted as material used to construct a collection basin for the discharge outlet for the outfall pipe shown on Figure 1.
3. The initial outfall pipe (Figure 1) was constructed in 1986 and was extended to the south by a corrugated metal flume. The buried outfall pipe (Figure 1) extending to the southeast was added in either 1987 or 1988. The construction of both pipes would have resulted in the displacement and re-burial of a substantial amount of landfill material.
4. The drainage ditch shown to the east of the outfall pipes was visible on vertical aerial photographs from 1955 through 1981, and was apparently covered or partially filled by 1983. The ditch is clearly visible on oblique photographs taken in 1967 and 1969, which show a culvert under the railroad tracks and probably under the main road. There is no photographic evidence that the culvert was removed, sealed, or extended before the ditch was covered.

5. The berm shown to the south of the west end of the landfill is shown under construction in oblique photographs taken on November 15, 1967. Oblique photographs taken on June 5, 1969, July 11, 1969, and May 15, 1970, show the area behind the berm (north side) in various stages of being filled with rubble and a number of large unidentifiable objects. It may be significant to note that one of the ^{238}U anomalies detected by the HPGe survey occurred just to the south of this berm.
6. Oblique photographs show that the pond identified on the 1955 vertical aerial photograph and interpreted to be filled in on subsequent photographs, is now interpreted to have been completely washed out in later years. Consequently, any sludge or sediments that would have accumulated when the pond was in use (indicated filter backwash site) may have spread out below the pond site or been deposited in Woman Creek prior to the construction of the South Interceptor Ditch (SID).
7. Aerial photographs indicate that the landfill was operated as an area fill. Waste appears to have been dumped over the southern edge of the alluvial pediment on which the plant site is located and spread over the southerly facing slopes incised by Woman Creek. Groundtruthing conducted as part of the aerial photo review process suggests that the landfill cover is intact above the topographic break described above. Below the topographic break, the cover appears to be eroded with numerous slumps which locally expose some of the waste.

2.2 RADIATION SURVEY

During the period of October 25, 1990 to December 8, 1990, a gamma radiation survey was conducted over the original landfill using a 20 percent N-type, high purity germanium (HPGe) detector (DOE, 1992). The survey data is presented in Volume II of the Phase I RFI/RI Work

Plan. Review of the data contained in the Work Plan indicates that activity from most of the detected isotopes were consistent with natural background; however, there were areas that exhibited elevated uranium ²³⁸ activity (hot spots). These hot spots are shown on Figure 2.

The conclusions drawn from the HPGe survey are summarized below.

1. Volume II, Appendix B, Figure 5 of the OU5 Work Plan shows contours for a large anomaly located over the central portion of the landfill. This anomaly encompasses survey stations C-8, C-9, B-7 and B-8 shown on Figure 2. This anomaly is most likely a composite of point sources. Anomalies herein are referenced to stake coordinates listed in Volume II, Appendix B Table 2 of the OU5 Work Plan.
2. Anomalies D-3 and P-2 detected to the south and east of the landfill respectively appear to be related to landfill material that was excavated during the construction of the SID.
3. The location and source for the anomaly at SP-2 is documented by photographs 19, 20 and 21 in a volume entitled Photographs of Woman Creek, OU5. The description for one of the photographs includes the coordinates (with a typographical error) of the source, which exactly coincide with the coordinates of SP-2. The photographs show the object known to be the source for SP-2 protruding through the landfill.
4. All of the indicated ²³⁸U occurrences along the "W" line (survey points W-2, W-8 and W-11) which extends along the north bank of Woman Creek appear to be related to natural features which drain into the creek. The locations of the B-7, B-8, C-8, C-9, D-3, P-2, and SP-2 hot spots have been land surveyed and marked with stakes. Sample locations for the "W" line hot spots will be identified in the

field by means of a compass, measuring tape and surveyed markers installed as part of the geophysical and SOV surveys. State plane coordinates for each of the hot spots are listed in Table 1 and surface soil samples will be collected at these locations.

2.3 GEOPHYSICAL SURVEYS

Magnetometer and electro-magnetic (EM) surveys will be conducted on and downgradient of the original landfill. The surveys will also cover the disturbed area to the east of the original landfill. The surveys may provide additional information regarding the areal extent of the original landfill. If the areal extent of the landfill extends beyond the current projected boundary, an additional soil sampling program may be required. If the areal extent of the landfill is increased, a Technical Memorandum will address the new boundaries and the need for additional soil sampling. Initiating the soil sampling program prior to full analysis of the electro-magnetic, magnetic and SOV survey will help in making up lost time caused by other delays already experienced in implementation of the OU5 Work Plan.

2.4 SOIL ORGANIC VAPOR SURVEY

A real-time soil organic vapor (SOV) survey will be conducted over the original landfill and the disturbed area to the east of the landfill. The SOV survey will be used to identify plumes of volatile contaminants that may be present beneath and downgradient of the original landfill. The results of the SOV will assist in the selection of locations for soil borings conducted during Stage 3 investigation activities.

TABLE 1
RADIATION HOT SPOTS AND DISTURBED AREA
SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - IHSS 115

Sample No.	Surface Soil Sample Location No.	Hot Spot Survey No.	State Plane Coordinates	
SS50001ASU5	SS505092	SP-2	E2081190	N747882
SS50002ASU5	SS505192	D-3	E2081194	N747564
SS50003ASU5	SS505292	B-7	E2081794	N747865
SS50004ASU5	SS505392	C-8	E2081944	N747715
SS50005ASU5	SS505492	B-8	E2081994	N747864
SS50006ASU5	SS505592	C-9	E2082094	N747714
SS50007ASU5	SS505692	P-2	E2082336	N747656
SS50008ASU5	SS505792	W-2	E2080905	N747262
SS50009ASU5	SS505892	W-8	E2081944	N747408
SS50010ASU5	SS505992	W-11	E2082425	N747471
SS80001ASU5*	SS505992	W-11	E2081425	N747471

* Duplicate sample

The last 2 digits of the sample location number (92) may change to 93 based upon the year the sample is collected.

3.0 SURFACE SOIL SAMPLING PROGRAM

3.1 SOIL SAMPLE LOCATIONS - LANDFILL

Radiation anomalies and the areal extent of the original landfill have been defined based upon the Stage 1 data review activities described above. Surface soil sampling activities will focus on the radiation hot spots, the landfill cover material and the disturbed area to the east of the landfill.

Ten hot spots were identified during the review of the 1990 gamma radiation survey. As explained in Section 2.2, item 3, the source for the anomaly at SP-2 is documented, therefore; with the exception of hot spot SP-2, one surface soil sample will be collected near the center of each of the 1990 gamma radiation survey hot spots (Figure 2) using the Rocky Flats surface soil sampling methods described in EG&G Operating Procedure GT.8. One surface soil sample will be collected downgradient of the source for SP-2 to determine if runoff has transported contamination from the source. The source for SP-2 protrudes through the ground, therefore; sample locations for SP-2 will be determined in the field at the time of sampling based upon health and safety considerations. Samples collected from hot spots will be analyzed for those radionuclides shown in Table 2.

In accordance with section 7.2.1 of the OU5 Work Plan at least three surface soil samples will be collected from the disturbed area to the east of the original landfill. The sample locations were selected by overlaying a grid of 52 sequentially numbered cells with map scale dimensions of 50 feet by 50 feet on a map of the study area. The RANDOMIZE and RND functions of Quick Basic were used to generate three random numbers in the range of 1 to 52 as follows.

```
10 RANDOMIZE (random number seed 212)
20 FOR J= 1 TO 3
30 L=INT(52*RND(1))+1
40 PRINT L
50 NEXT J
```

TABLE 2
IHSS 115
ANALYTICAL PARAMETERS

TARGET ANALYTE LIST - METALS	DETECTION LIMITS Soil (mg/kg)
Aluminum	40
Antimony	12
Arsenic	2
Barium	40
Beryllium	1.0
Cadmium	1.0
Calcium	2000
Cesium	200
Chromium	2.0
Cobalt	10
Copper	5.0
Cyanide	10
Iron	20
Lead	1.0
Lithium	20
Magnesium	2000
Manganese	3.0
Mercury	0.2
Molybdenum	40
Nickel	8.0
Potassium	2000
Selenium	1.0
Silver	2.0
Sodium	2000
Strontium	40
Thallium	2.0
Tin	40
Vanadium	10.0
Zinc	4.0

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

BASE NEUTRAL EXTRACTABLES - SEMIVOLATILES	QUANTITATION LIMITS* Soil (ug/kg)
bis(2-Chloroethyl) ether	330
1,3-Dichlorobenzene	330
1,4-Dichlorobenzene	330
Benzyl Alcohol	330
1,2-Dichlorobenzene	330
2-Methylphenol	330
bis(2-Chloroisopropyl) ether	330
4-Methylphenol	330
N-Nitroso-di-n-dipropylamine	330
Hexachloroethane	330
Nitrobenzene	330
Isophorone	330
Benzoic Acid	1600
bis(2-Chloroethoxy) methane	330
1,2,4-Trichlorobenzene	330
Naphthalene	330
4-Chloroaniline	330
Hexachlorobutadiene	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	330
2-Methylnaphthalene	330
Hexachlorocyclopentadiene	330
2,4,5-Trichlorophenol	1600
2-Chloronaphthalene	330
2-Nitroaniline	1600
Dimethylphthalate	330
Acenaphthylene	330
2,6-Dinitrotoluene	330

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

BASE NEUTRAL EXTRACTABLES - SEMIVOLATILES	QUANTITATION LIMITS* Soil (ug/kg)
3-Nitroaniline	1600
Acenaphthene	330
Dibenzofuran	330
2,4-Dinitrotoluene	330
Diethylphthalate	330
4-Chlorophenyl Phenyl ether	330
Fluorene	330
4-Nitroaniline	1600
4,6-Dinitro-2-methylphenol	1600
N-nitrosodiphenylamine	330
4-Bromophenyl Phenylether	330
Hexachlorobenzene	330
Phenanthrene	330
Anthracene	330
Di-n-butylphthalate	330
Fluoranthene	330
Pyrene	330
Butylbenzylphthalate	330
3,3'-Dichlorobenzidine	660
Benzo(a)anthracene	330
Chrysene	330
bis(2-Ethylhexyl)phthalate	330
Di-n-octylphthalate	330
Benzo(b)fluoranthene	330
Benzo(k)fluoranthene	330
Benzo(a)pyrene	330
Indeno(1,2,3-cd)pyrene	330
Dibenz(a,h)anthracene	330
Benzo(g,h,i)perylene	330

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

TARGET COMPOUND LIST - PESTICIDES/PCBS	QUANTITATION LIMITS* Soil (ug/kg)
alpha-BHC	8.0
beta-BHC	8.0
delta-BHC	8.0
gamma-BHC (Lindane)	8.0
Heptachlor	8.0
Aldrin	8.0
Heptachlor epoxide	8.0
Endosulfan I	8.0
Dieldrin	16.0
4,4'-DDE	16.0
Endrin	16.0
Endosulfan II	16.0
4,4'-DDD	16.0
Endosulfan sulfate	16.0
4,4'-DDT	16.0
Methoxychlor	80.0
Endrin ketone	16.0
alpha-Chlordane	80.0
gamma-Chlordane	80.0
Toxaphene	160.0
Aroclor-1016	80.0
Aroclor-1221	80.0
Aroclor-1232	80.0
Aroclor-1242	80.0
Aroclor-1248	80.0
Aroclor-1254	160.0
Aroclor-1260	160.0

TABLE 2 - Continued
IHSS 115
ANALYTICAL PARAMETERS

RADIONUCLIDES	REQUIRED DETECTION LIMITS* Soil (pCi/g)
Gross Alpha	4 dry
Gross Beta	10 dry
Uranium 233+234, 235, and 238 (each species)	0.3 dry
Americium 241	0.02 dry
Plutonium 239+240	0.03 dry
Tritium	400 (pCi/ml)
Cesium 137	0.1 dry
Strontium 89+90	1 dry

* Detection and quantitation limits are highly matrix dependent. The limits listed here are the minimum achievable under ideal conditions. Actual limits may be higher.

OTHER PARAMETERS	REQUIRED DETECTION
Bulk Density	0.1 gm/cm ³
Particle Size Analysis	+200 sieve
Specific Conductance	2.5 umoh/cm
Carbonate	2 mg/kg
pH	0.1 pH units
Total Organic Carbon	1 mg/kg

Three grid cells corresponding to the numbers generated by Quick Basic were selected as the proposed sample locations (Figure 3). These samples will be collected according to the Rocky Flats soil sampling method and analyzed for both the radionuclides and conventional analytes shown in Table 2.

In addition to the samples described above, surface soil sampling will be used to characterize the radiological and chemical concentrations in the landfill cover for risk assessment. A total of 51 surface soil samples will be collected at 100-foot grid spacings (Figure 3). The surface soil sampling program was developed in accordance with applicable EPA guidance, including:

- Soil Sampling Quality Assurance User's Guide - Second Edition (EPA/600/8-89/046), March 1989 (EPA, 1989a);
- Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites (EPA/540/P-91/001), February 1991 (EPA, 1991);
- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A (EPA/540/1-89/002), December 1989 (EPA, 1989b); and
- Guidance for Data Usability in Risk Assessment (Publication 9285.7-09A), April 1992 (EPA, 1992).

Systematic grid sampling was selected because this procedure is useful for the range of statistical procedures which could be required for the assessment of soil contact exposures. Statistical procedures which could be required depend on the spatial distribution of chemical and radiological parameters in the landfill cover. The statistical procedures which could be required and which are supported by systematic sampling include:

- 1) geostatistical estimation of local concentrations (i.e., in portions of the landfill cover). Local concentration estimates will differ from the global (i.e., total landfill area) average if concentrations are spatially variable. If concentrations are elevated within potential exposure areas (i.e., portions of the landfill where

activity could be concentrated), local estimates would be useful in calculating the reasonable maximum exposure (RME); and

- 2) classical estimation of the average concentration and 95 percent upper confidence limit (UCL) of the average across the landfill cover. Classical estimation is appropriate for calculating RME where concentrations are evenly distributed (i.e., no patterns of spatial variation are evident).

The 100-foot grid spacing was selected based on the spatial distribution of the HPGE data for radiological parameters in the landfill cover, the likely spatial distribution of the chemical parameters, and the potential activity patterns in which the landfill cover material would be contacted. Each of these factors is discussed below.

HPGE Data for Radiological Parameters

With the exception of U-238 radiological parameters in the HPGE data were evenly distributed across the site with low coefficient of variation. Because the HPGE data indicate that concentrations are likely to be evenly distributed, classical methods may be appropriate to calculate the RME. Based on a total sample size of 51 and a low coefficient of variation, a precise estimate of the RME can be calculated.

The precision of the classical RME estimate is illustrated by a sample calculation for Thorium-232. The one-sided 95 percent UCL would be used for the classical RME estimate. Use of the UCL ensures that there is only a 5 percent chance that the true average concentration is underestimated.

The one-sided 95 percent UCL for the arithmetic average is calculated as follows (Gilbert, 1987):

$$UCL = \bar{x} + t_{0.95, n-1} s$$

where,

UCL = Upper confidence limit

\bar{x} = Arithmetic average concentration

$t_{0.95, n-1}$ = 95th percentile of the t-distribution with n-1 degrees of freedom

n = Number of samples

s = Standard error, i.e., the standard deviation divided by the square root of n

sd = Standard deviation

From the Thorium-232 HPGE data,

$$\bar{x} = 1.35 \text{ pCi/g,}$$

$$sd = 0.33$$

Using a proposed sample size of 51,

$$s = 0.05 \text{ pCi/g}$$

From statistical tables,

$$t_{0.95, 50} = 1.68$$

Therefore, based on a proposed sample size of 51, the calculated UCL would be,

$$UCL = 1.35 + (1.68)(0.05)$$

$$= 1.35 + 0.08$$

Therefore, based on the HPGE data for Thorium-232, the calculated UCL would be only six percent (0.08/1.35) higher than the arithmetic average concentration.

Potential Distribution of Chemical Parameters

No data are available for the chemical parameters. However, possible localized areas of elevated concentrations could exist. Likely sources of spatial variation include:

- possible use of different soils for landfill cover material; and
- possible partial erosion of cover material in portions of the landfill.

From the likely sources of variation, localized areas of elevated concentrations (i.e., hot spots) would be associated with the landfill construction pattern and physical features. In particular, trends (i.e., spatial continuity) in concentrations may exist across adjacent cell areas, due to wind erosion patterns, and also since adjacent landfill cells were covered at similar times. The areal dimensions of the landfill cells are estimated to be 50 feet by 100 feet. Therefore, the 100-foot grid spacing will locate a sample within every second landfill cell area, so that localized spatial variation can be evaluated.

Potential Activity Patterns

Contact with landfill cover material would most likely occur through wind transport of particulates to adjacent areas. The 100-foot grid spacing will support local estimation on the 100-foot scale, so that the RME associated with potential future use activity patterns can be calculated.

The state plane coordinates of each proposed surface soil sample location are listed in Table 3. Sample locations will be identified in the field by means of a compass, measuring tape, and surveyed markers installed as part of the geophysical and SOV surveys. The location of each surface soil sample will be staked at the time the sample is collected and land surveyed at a later date. Up to five additional surface soil samples may be collected at locations where stained soil, stressed vegetation or other field indications of contamination are observed or detected.

TABLE 3
RANDOM SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - IHSS 115

Sample No.	Surface Soil Sample Location No.*	State Plane Coordinates	
SS50011ASU5	SS506092	E2080843	N747767
SS50012ASU5	SS506192	E2080943	N747767
SS50013ASU5	SS506292	E2081043	N747767
SS50014ASU5	SS506392	E2081143	N747867
SS50015ASU5	SS506492	E2081143	N747767
SS50016ASU5	SS506592	E2081143	N747667
SS50017ASU5	SS506692	E2081243	N747867
SS50018ASU5	SS506792	E2081243	N747767
SS50019ASU5	SS506892	E2081243	N747667
SS50020ASU5	SS506992	E2081343	N747967
SS800024SU5***	NA	NA	NA
SS80003ASU5**	SS506992	E2081343	N747967
SS50021ASU5	SS507092	E2081343	N747867
SS50022ASU5	SS507192	E2081343	N747767
SS50023ASU5	SS507292	E2081343	N747667
SS50024ASU5	SS507392	E2081443	N747967
SS50025ASU5	SS507492	E2081443	N747867
SS50026ASU5	SS507592	E2081443	N747767
SS50027ASU5	SS507692	E2081543	N747967
SS50028ASU5	SS507792	E2081543	N747867

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.

** Duplicate Sample

*** Rinsate Sample

NA-Sample location number and state plane coordinates are not applicable to rinsate samples.

TABLE 3
SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - ORIGINAL LANDFILL

Sample No.	Surface Soil Sample Location No.	State Plane Coordinates	
SS50029ASU5	SS507892	E2081543	N747767
SS50030ASU5	SS507992	E2081543	N747667
SS80004ASU5**	SS507992	E2081543	N747667
SS50031ASU5	SS508092	E2081543	N747567
SS50032ASU5	SS508192	E2081643	N747967
SS50033ASU5	SS508292	E2081643	N747567
SS50034ASU5	SS508392	E2081643	N747767
SS50035ASU5	SS508492	E2081643	N747667
SS50036ASU5	SS508592	E2081643	N747567
SS50037ASU5	SS508692	E2081743	N747967
SS50038ASU5	SS508792	E2081743	N747867
SS50039ASU5	SS508892	E2081743	N747767
SS50040ASU5	SS508992	E2081743	N747667
SS80005ASU5***	NA	NA	NA
SS80006ASU5**	SS508992	E2081743	N747667
SS50041ASU5	SS509092	E2081843	N748067
SS50042ASU5	SS509192	E2081843	N747967
SS50043ASU5	SS509292	E2081843	N747867
SS50044ASU5	SS509392	E2081843	N747767
SS50045ASU5	SS509492	E2081843	N747667

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.

** Duplicate Sample

*** Rinsate Sample

NA-Sample location number and state plane coordinates are not applicable to rinsate samples.

TABLE 3
SURFACE SOIL SAMPLE LOCATION NUMBERS
STATE PLANE COORDINATES
AND SAMPLE NUMBERS - ORIGINAL LANDFILL

Sample No.	Surface Soil Sample Location No.	State Plane Coordinates	
SS50046ASU5	SS509592	E2081843	N747567
SS50047ASU5	SS509692	E2081843	N747467
SS50048ASU5	SS509792	E2081943	N747967
SS50049ASU5	SS509892	E2081943	N747867
SS50050ASU5	SS509992	E2081943	N747767
SS80007ASU5**	SS509992	E2081943	N747767
SS50051ASU5	SS510092	E2081943	N747667
SS50052ASU5	SS510192	E2081943	N747567
SS50053ASU5	SS510292	E2081943	N747467
SS50054ASU5	SS510392	E2082043	N747967
SS50055ASU5	SS510492	E2082043	N747867
SS50056ASU5	SS510592	E2082043	N747767
SS50057ASU5	SS510692	E2082043	N747667
SS50058ASU5	SS510792	E2082043	N747567
SS50059ASU5	SS510892	E2082043	N747467
SS50060ASU5	SS510992	E2082134	N747967
SS80008ASU5***	NA	NA	NA
SS80009ASU5**	SS510992	E2082134	N747967
SS50061ASU5	SS511092	E2082243	N747967
SS50062ASU5	SS511192	E2082340	N747825
SS50063ASU5	SS511292	E2082391	N748071
SS50064ASU5	SS511392	E2082590	N748025

* Sample location #s on Figure 3 correspond to the #s in the 5th and 6th position of the surface soil sample location #; e.g. #60 on Figure 3 corresponds to surface soil sample location # SS506092.

** Duplicate Sample

*** Rinsate Sample

NA-Sample location number and state plane coordinates are not applicable to rinsate samples.

One field duplicate sample will be taken for every 10 soil samples collected and one rinsate sample will be collected for every 20 samples collected. These quality control sampling procedures are in accordance with the modified Quality Assurance Addendum to the OU5 Work Plan (DOE, 1992).

3.2 FIELD PROCEDURES

Field procedures for collecting surface soil samples are specified in EG&G Operating Procedure GT.8 (EG&G, 1992a). Samples collected for both radiological and conventional analysis will be collected according to the Rocky Flats method, Section 5.0 of GT.8 (EG&G, 1992a). Equipment needed for surface soil sampling is specified in GT.8 (EG&G, 1992a). Decontamination will be in accordance with EG&G Operating Procedure FO.3 (EG&G, 1992b). Sample labeling, shipment, and preservation will be conducted according to EG&G Operating Procedures FO.13 (EG&G, 1992c). Sample designations, documentation, data package preparation, and sample tracking will be in accordance with EG&G Operating Procedure FO.14 (EG&G, 1992d). Data Reduction, Validation and Reporting will be in accordance with section 3.9 of the Quality Assurance Addendum to the OU5 Work Plan (DOE, 1992) and section 3.4 of the Quality Assurance Project Plan (EG&G, 1991).

A summary of surface soil sampling field methods is provided below, details of the methods are given in the EG&G Operating Procedures.

- 1.0 The radiation survey results must satisfy the pre-work area radiation monitoring requirements and forms FO.16A and FO.16B must be completed - SOP FO.16.
- 2.0 The following decontamination equipment must be assembled for field use as required by FO.3: liquinox, bristle brushes (all plastic), Rocky Flats Plant tap water or distilled water, non-reactive plastic wrap, plastic wash and rinse tubs, plastic sheeting for use as a ground cloth, and paper towels.

- 3.0 The following sampling equipment must be obtained as required by FO.13: sample glassware with preservative (see Table 4), coolers, thermometer, blue ice, sample labels, chain of custody forms, custody seals, zip-lock bags, bubble wrap, vermiculite, strapping tape, clear tape, a carboy for transport of rinsate, and the forms included in Appendix I of this document.

Surface soil samples will be collected according to the Rocky Flats method. The following sample collection equipment must be obtained as required by GT.8: soil sampling jig (10 x 10 x 5 cm), spare sampling jig parts, stainless steel scoop, brushes, wire, paint, new 1 gallon metal paint cans, hammer, miscellaneous cold chisels, pointed cement trowel, black waterproof marking pens, metric rule, wood block (10 x 10 x 30 cm), site selection plan, health and safety equipment including PID and radiation survey instrument, and logbook.

- 4.0 Sampling equipment will be decontaminated in accordance with FO.3 and documented on form FO.3A. Disposal of decontamination water shall be in accordance with FO.7, section 6.1.1. Steam cleaning of sample coolers and previously used disposal drums is required.

- 5.0 Sampling sites will be located using a steel tape, compass and survey monuments; coordinates for the sample locations are given in Table 3 of this document. Surface soil samples for radiological and conventional analyses will be collected in accordance with the Rocky Flats method, GT.8, section 5.2.3. Briefly, this method consists of compositing ten soil samples collected from the center and each corner of two one-meter squares that are spaced one-meter apart at each sampling location.

All sampling activities will be documented in a field logbook and on forms GT.8A and GT.8B. Documentation will include the following items listed in EG&G

Operating Procedure FO.13 section 6.4: sampling activity name and number, sampling point name and number, sample number, name(s) of collector(s) and others present, date and time of sample collection, sample container tag/label number (if appropriate), preservative(s), requested analyses, sample matrix, filtered or unfiltered, designation of QC samples, collection methods, chain of custody control numbers, field observations and measurements during sampling, and signature.

Samples will be processed for shipment in accordance with FO.13 and the chain of custody (COC) form will be completed and a COC number assigned to it.

6.0 Field equipment will be decontaminated in between sample locations in accordance with FO.3, disposal of the leftover rinsate will be in accordance with FO.7, Section 6.1.1.

7.0 The data tracking process will be in accordance with FO.14 using form FO.14A. The data entry process will be as prescribed on forms FO.14C, FO.14H and FO.14K.

3.3 ANALYTICAL PARAMETERS

Each surface soil sample shown in Figure 3 will be analyzed for target analyte list (TAL) metals, total organic carbon (TOC), semi-volatiles (base neutral extractables), TCL pesticides, and a suite of radioanalytes specified in Table 2. Acid extractables will not be analyzed as specified in the OU5 Work Plan. This class of compounds has low adsorption coefficient (K_{oc}) values ranging from 27 to 900 and high water solubility (WS) values ranging from 14 to over 82,000 ppm. These values are indicative of chemicals that do not adsorb to soil ($K_{oc} < 1000$) and are mobile in the environment ($WS > 10$ ppm). Soil samples collected from hot spots identified during the review of the 1990 gamma radiation survey and shown in Figure 2 will be analyzed for the suite

of radioanalytes specified in Table 2. Tritium exists in the environment as tritiated water. If it were in the surficial soils, it would have been removed by infiltration and runoff due to its high mobility in the environment. Therefore, tritium will not be analyzed as specified in the OU5 Work Plan. All analytical work will be conducted by an EG&G contract laboratory. Holding times, preservatives, and sample containers for each of the analytes are shown in Table 4.

TABLE 4
ANALYTES, SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Analyte	Container	Preservative	Holding Time
TAL Metals	Soil - 8oz. wide mouth glass jar.	None	6 months ^a
	Rinsate - 1 liter plastic bottle.	Nitric acid pH < 2 and Cool 4° C	6 months ^a
TOC	Soil - 8oz. wide mouth glass jar.	Cool 4° C	28 days
Semi-volatiles (base neutral extractables)	Soil - 8oz. wide mouth glass jar with Teflon liner.	Cool, 4 deg. C	7 days until extraction, 40 days post extraction.
	Rinsate - 4 liter amber glass bottle.	Cool, 4 deg. C	7 days until extraction, 40 days post extraction.
TCL Pesticides	Soil - 8oz. wide mouth glass jar with Teflon liner.	Cool, 4 deg. C	7 days until extraction, 40 days post extraction.
	Rinsate - 4 liter amber glass bottle.	Cool, 4 deg. C	7 days until extraction, 40 days post extraction.
Radiological Tests - gross alpha, gross beta, U ^{233/234} , U ²³⁵ , U ²³⁸ , Pu ^{239/240} , Am ²⁴¹	Soil - 500 mL wide mouth glass jar.	None	None
	Rinsate - 3 x 4 liter plastic containers.	Nitric acid pH < 2	6 months

^a Holding Time for Mercury is 28 days.

TABLE 4 - Continued
ANALYTES, SAMPLE CONTAINERS, PRESERVATIVES AND HOLDING TIMES

Other Parameters	Container	Preservative	Holding Time
Bulk Density	1 Pint	None	Not Applicable
Particle Size Analysis	1 Pint	None	Not Applicable
Specific Conductance	8 oz	Cool 4°C	28 days
Carbonate	8oz	None	ASAP
pH	4oz	None	Immediately

4.0 REFERENCES

DOE (Department of Energy), 1992, Final Phase I RFI/RI Work Plan for Rocky Flats Woman Creek Priority Drainage (Operable Unit No. 5), Revision 1, February.

EG&G, 1991 Environmental Restoration Program (ERP) Quality Assurance Project Plan For CERCLA Remedial Investigations/Feasibility Studies and RCRA Facility Investigations/Corrective Measures Studies Activities, May 5, 1991.

EG&G, 1992a Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) GT.9, Revision 2, Surface Soil Sampling, March 1, 1992.

EG&G, 1992b Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.3, Revision 2, General Equipment Decontamination, March 1, 1992.

EG&G, 1992c Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.13, Revision 2, Containerization, Preserving, Handling and Shipping of Soil and Water Samples, March 1, 1992.

EG&G, 1992d Environmental Management Department (EMD) Manual Operation Standard Operating Procedure (SOP) FO.14, Revision 2, Field Data Management, March 1, 1992.

EPA (Environmental Protection Agency), 1986, Test Methods for Evaluating Solid Waste, SW-846, Third Edition, November, 1986.

EPA (Environmental Protection Agency), 1988, Aerial Photographic Analysis Comparison Report, US DOE, Rocky Flats, Golden, Colorado, Appendix A, EPA Region 8, TS-PIC-88760, July 1988.

EPA (Environmental Protection Agency), 1989a, Soil Sampling Quality Assurance User's Guide, (EPA/600/8-89/046), Second Edition, March, 1989.

EPA (Environmental Protection Agency), 1989b, Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual - Part A, (EPA/540/1-89/002), December, 1989.

EPA (Environmental Protection Agency), 1991, Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites, (EPA/540/P-91/001), February, 1991

EPA (Environmental Protection Agency), 1992, Guidance for Data Usability in Risk Assessment (Publication 9285.7-09A), April, 1992.

Gilbert, R.O., 1987, Van Norstrand Reinhold, Statistical Methods for Environmental Pollution Monitoring.

APPENDIX I

EG&G SAMPLE DOCUMENTATION FORMS

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____ **Work Surface Wet (Y/N):** _____

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

_____ cpm at Point of Intrusive Activity _____ Highest Measured cpm

[illegible]

Completed By: _____

Print Name	Signature	Date
------------	-----------	------

Subcontractor: _____

RESULTS OF RADIOLOGICAL MEASUREMENTS IN THE FIELD

Project Name: _____

Date: _____ Site Number: _____

Snow Cover Present (Y/N): _____

1. Instruments Used and Background Readings

Manufacturer and Model No.	Serial Number	Probe Type	Probe Serial No.	Calibration Due Date	Background Reading (cpm)

2. PPE Monitoring

_____ PPE monitoring not required. Work area was characterized as uncontaminated and field radiological screening as work progressed did not indicate the presence of potential contamination.

If PPE monitoring required complete the following table

Ludlum Model 12	Bicron Analyst Fidler	PPE screening resulted in verified positive reading (Y/N)	Time	PPE Verified positive reading (cmp)	Smear No.

Completed By: _____
Print Name Signature Date

Subcontractor: _____

DRUM FIELD LOG FORM

NAME OF THE SUBCONTRACTOR _____

DRUM ID NUMBER WITH SUB. ID _____

DRUM ISSUE DATE _____

LOCATION OF ISSUANCE _____

PROJECT NAME & NUMBER _____

LOCATION OF FIELD ACTIVITY _____

ASSOCIATED WELL, BORING, OR _____

CONTENTS OF DRUM _____

SUBSURFACE INTERVALS (IF SOILS)

ASSOCIATED SAMPLE ID NUMBERS

DATE DRUM WAS FILLED _____

SIG. OF PERSON FILLING THE DRUM _____

IF SOLID ENVIRONMENTAL MATERIALS

LOCATION OF TEMP. STORAGE AREA _____

DATE DRUM RETURNED TO EG&G _____

SIG. OF EG&G REPRESENTATIVE _____

IF ENVIRONMENTAL LIQUIDSDATE & LOCATION WHERE CONTENTS
WERE EMPTIED AND DECONNED

(e.g. 2/18/91 DECON PAD # _____)

DATE

LOCATION

[illegible]

**CONTAMINANT CHARACTERIZATION FORM
FOR GRAY DRUMS PENDING CHARACTERIZATION****ATTACH CHEMICAL RESULTS OF ASSOCIATED SAMPLES****THIS PORTION WILL BE COMPLETED BY THE SUBCONTRACTOR**

Name of the Subcontractor Issued the Drum
The Serialized Drum ID Number with the Subcontractor's ID
The Drum Issue Date
The Location of the Field Activity Area
The Associated Well, Boring, or Sampling Location
The Contents of the Drum
Subsurface Intervals (Ft), if Soils or Bag Numbers, if PPE

The Date the Drum was Filled
Matrix of Samples Analyzed
ASSOCIATED SAMPLES

Sample No.	Depth (ft)	Sample No.	Depth (ft)	Sample No.	Depth (ft)

Date Submitted to EG&G for Characterization
Subcontractor's Representative Signature

THIS PORTION WILL BE COMPLETED BY EG&G

The Contaminant Characterization of the Drum's Contents
Signature of EG&G Representative Determining the
Contaminant Characterization and Date Signed

Date

EG&G Holding Facility Where Drum Will be Stored

Date and Time Form Returned to Waste Operations Date Time

EQUIPMENT DECONTAMINATION/WASH CHECKLIST AND RECORD

I. General Information completed by: _____

Name _____

Date _____

Phone No. _____

Subcontractor's Name _____

NOTE: Sections I and II will be completed by the same individual.

Equipment Manufacturer, Model and Common Name: _____

Equipment Owner: _____

Name and Phone Number of Person Responsible for the Equipment: _____

Serial Number/Equipment Identification Number: _____

Delivered to Decontamination Station by: _____

Initial contaminate characterization of work area: (check one)

Not potentially contaminated _____

Potentially contaminated _____

II. Activity History

Where was equipment used? _____

What was equipment used for? _____

Types and volumes of water generated: (check as appropriate)

_____ Purge	_____ Gallons
_____ Development	_____ Gallons
_____ Decon/Wash	_____ Gallons
_____ Rinse	_____ Gallons

EQUIPMENT DECONTAMINATION/WASH CHECKLIST AND RECORD

III. Actions At Central Decontamination Station

Yes

No

_____ The equipment was washed under the provisions of SOP No. FO.3, General Equipment Decontamination

_____ Personnel Decontamination Station established as described in the applicable site-specific health and safety plan

_____ Personal protective equipment (PPE) selected based upon work area PPE level

_____ Specify PPE level utilized:
_____ Level B _____ Level C _____ Level D

_____ PPE inspected prior to donning

_____ Wind direction checked prior to using pressurized spray (circle the direction the wind was blowing from)
N NE E SE S SW W NW

_____ Was particular attention devoted to equipment parts that contacted potentially contaminated medium?

_____ Was personal decontamination completed as described in the applicable site-specific health and safety plan?

SURFACE SOIL
DATA COLLECTION FORM

Sample Number _____
Collection Date _____
Collection Time _____
Location Code _____
Chain of Custody No. _____

Coordinates North or Y _____ East or X _____

Sample Location _____

Composite (Y/N) _____
Composite Description _____

Collection Method _____
Sample Team Leader _____
Sample Team Member _____
Sample Team Member _____
Sample Team Member _____
Container Size (Oz) _____ % Full _____

Comments _____

Completed By: _____
Print Name Signature Date

Subcontractor: _____

Project Name

Site Identification

Date _____

Sampler

[illegible]

Completed By:

Print Name _____

Signature

Date _____

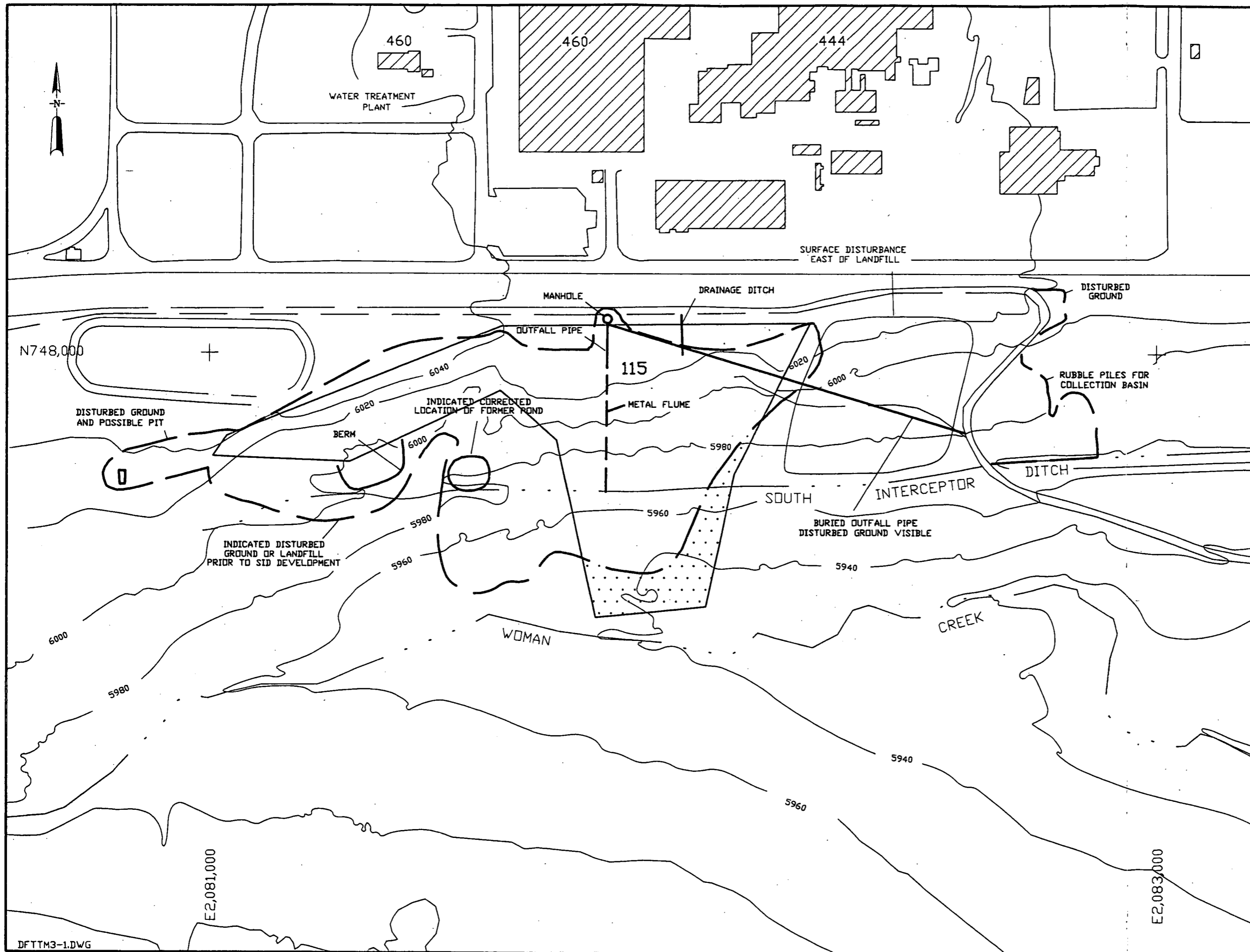
Subcontractor:

PROJECT #

LAB/LOCATION

EG&G ROCKY FLATS, CHAIN OF CUSTODY

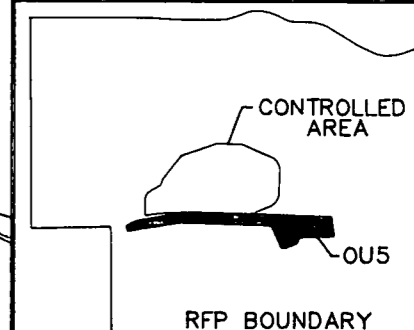
SHIP WHITE AND YELLOW COPIES WITH SAMPLES -- RETAIN PINK FIELD COPY



MAP LEGEND

- STREAMS DITCHES
DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- IHSS 115-
ORIGINAL LANDFILL
BOUNDARY (DOE, 1992)
- AMENDED LANDFILL
BOUNDARY BASED ON
AERIAL PHOTO REVIEW
- EPA AND CDH SOUTHERN
EXTENSION OF LANDFILL
BOUNDARY (DOE, 1992)
INCLUDED IN THIS STUDY

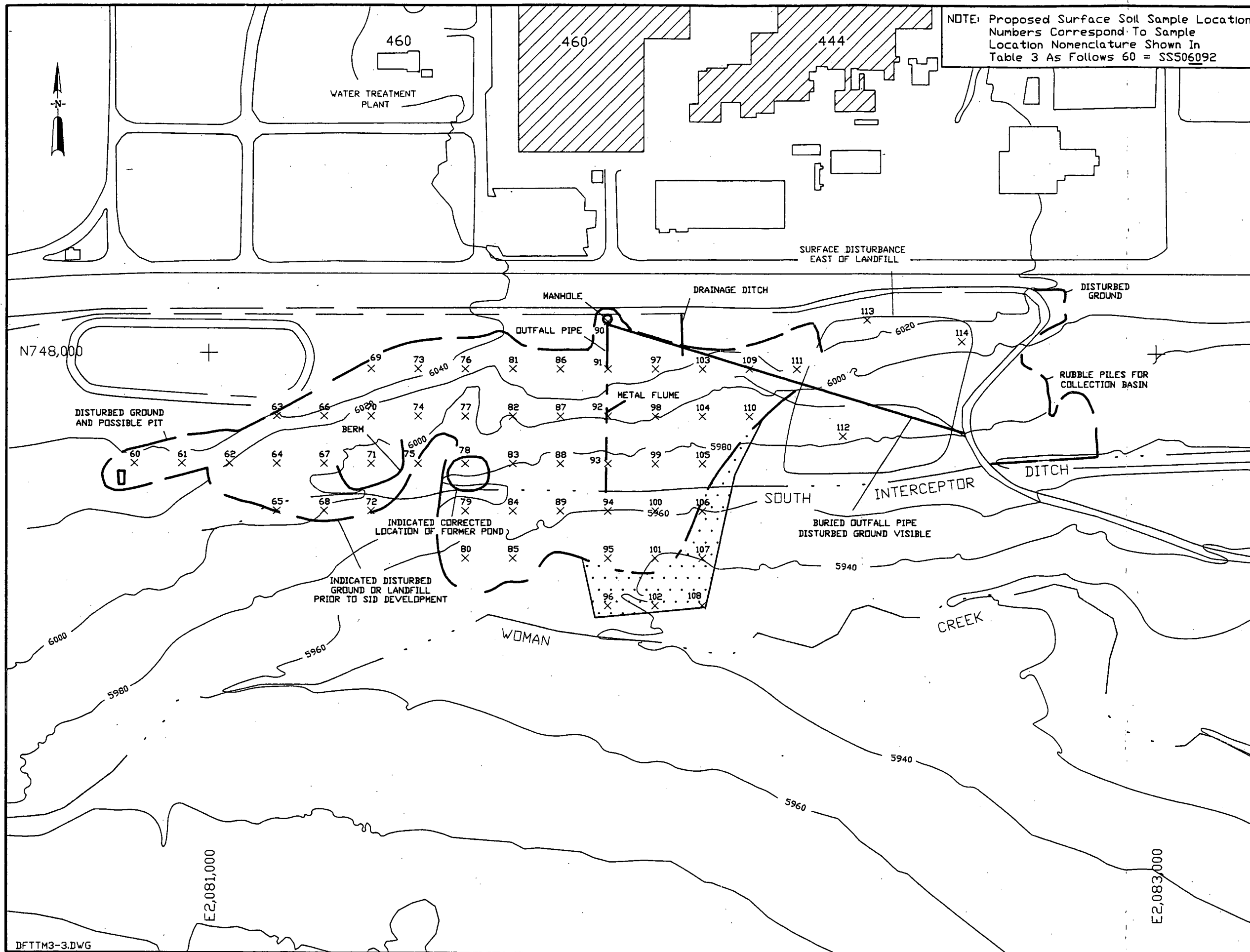
0 100 200
SCALE: 1" = 200'



IHSS 115 ORIGINAL LANDFILL
AND EXTENDED AREAS

OPERABLE UNIT 5
TECHNICAL MEMORANDUM 3

EG&G FIGURE 1
Rocky Flats Plant, Golden, Colorado



MAP LEGEND

- STREAMS DITCHES DRAINAGE FEATURES
- PAVED ROADS
- DIRT ROADS
- BUILDINGS
- AMENDED LANDFILL BOUNDARY BASED ON AERIAL PHOTO REVIEW
- EPA AND CDH SOUTHERN EXTENSION OF LANDFILL BOUNDARY (DOE, 1992) INCLUDED IN THIS STUDY
- PROPOSED SURFACE SOIL SAMPLE LOCATIONS

0 100 200

SCALE: 1" = 200'

CONTROLLED AREA

OU5

RFP BOUNDARY

IHS 115 ORIGINAL LANDFILL AND DISTURBED AREA SURFACE SOIL SAMPLE LOCATIONS

OPERABLE UNIT 5

TECHNICAL MEMORANDUM 3

EG&G **FIGURE 3**

Rocky Flats Plant, Golden, Colorado

